



Product Integrity Laboratory

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Emissions Test Report
Project Code CG-040023
(Report CG-040023-2)

Nortel MFRM2 800MHz CR - FCC Part 22 Report

Revision: 1

October 28, 2004

Prepared for: Nortel Networks

Author: Eric Warkentin
EMC Specialist

Approved by: Nick Kobrosly
Lab Manager

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Report Summary

NTS Canada

Product Integrity Laboratory
5151-47th Street, N.E. Calgary Alberta T3J 3R2

Accreditation Numbers: FCC 101386
IC 46405-3978 File # IC3978-2
Standards Council of Canada Accredited Laboratory No. 440

Performed For: Nortel Networks Inc.
5050-40th Street, N.E.
Calgary Alberta T3J 4P8
Phone (403) 769-2425

Customer Representative: Thomas Wong
CDMA / TDMA Regulatory Prime

EUT Description:

	Name	Model	Revision	Serial Number
EUT	MFRM2 CR	NRGY30AA	P5	NNTM536G2RE2
				NNTM536G2R3P
				NNTM536G2RG4
				NNTM536G2RF3
				NNTM536G2R9W
				NNTM536G2R2N
				NNTM536G2RC0
				NNTM536G2RD1

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Test Summary

Appendix	Standards		Description & Range	Deviations* from:			Pass / Fail	Criteria
	Base	Test Basis		Base Standard	Test Basis	NTS Procedure		
A	FCC CFR 47 Part 22	ANSI C63.4-2001	Radiated Emissions 30 MHz – 10 GHz	No	No	No	PASS	Subpart H

*Deviation details are outlined in the applicable appendix of this report

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Test Log and Signatures

Appendix	Test Case	Start	End	Tester / Date
A	Radiated Emissions - 30 MHz – 10 GHz FCC Part 22	October 5, 2004	October 9, 2004	 Eric Warkentin, EMC Specialist

The test outlined may not be inclusive of all testing required by the Base Standards or fulfill the applicable regulatory requirements in their entirety.

Test Result: The product presented for testing complied with test requirements as shown above.

Prepared By: _____
Eric Warkentin
EMC Specialist

Checked By: _____
Glen Moore
EMC Manager

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REGISTER OF REVISIONS

Revision	Date	Description of Revisions
0	October 28, 2004	Draft release for review
1	October 28, 2004	Customer release following internal review

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to describe the tests applied by NTS Canada to demonstrate compliance of Nortel Network's MFRM2 800MHz CR to the applicable Electromagnetic Compatibility (EMC) standards as outlined in section 1.3.

The test outlined may not be inclusive of all testing required by the Base Standards or fulfill the applicable regulatory requirements in their entirety.

1.2 ABBREVIATIONS AND DEFINITIONS

The following are the abbreviations and definitions that may be relevant to this document.

<u>Abbreviation</u>	<u>Explanation</u>
AF	Antenna Factor
ANSI	American National Standards Institute
AWG	American Wire Gauge
cm	centimetre
CF	Correction Factor
CFR	Code of Federal Regulations
CISPR	International Special Committee on Radio Interference
dB	Decibel
dB μ V	Decibel relative to 1 microvolt
DC	Direct Current
EMC	Electromagnetic Compatibility
EN	European Norms
EUT	Equipment Under Test
FCC	Federal Communications Commission
GHz	Gigahertz
Hpol	Horizontal Polarization
Hz	Hertz
kg	kilogram
kHz	kilohertz
LNA	Low Noise Amplifier
m	Metre
MHz	Megahertz
μ V	Microvolts
NA	Not Available
PI	Product Integrity
RE	Radiated Emissions
RF	Radio Frequency
Rx	Receive
SMA	SubMiniature version A
Tx	Transmit
VDC	Volts Direct Current
Vpol	Vertical Polarization

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Definitions:

Equipment Under Test (EUT): A representative ITE or functionally interactive group of ITE (that is a system), which includes one or more host units and is used for evaluation purposes.

Electromagnetic compatibility (EMC): The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

1.3 REFERENCES

US Code of Federal Regulations

- 47 CFR Part 22 Federal Communications Commission, Part 22, 10-01-97 edition

American National Standards Institute

- ANSI C63.4-2001 American National Standards for Methods of Measurements of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipments in the range of 9 kHz to 40 GHz, June 6, 2001
- ANSI C63.4-1992 American National Standards for Methods of Measurements of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipments in the range of 9 kHz to 40 GHz, July 17, 1992

NTS Documentation

- NTS Radiated Emissions 30MHz – 1GHz Automated Test Method E001R7
- NTS Radiated Emissions 1GHz – 18 GHz Manual Test Method E006R4
- NTS Radiated Emissions Substitution 30 MHz – 20 GHz Test Method 11.0

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2.0 EUT

2.1 CONFIGURATION

Description of EUT

	Name	Model	Revision	Serial Number
EUT	MFRM2 CR	NRGY30AA	P5	NNTM536G2RE2
				NNTM536G2R3P
				NNTM536G2RG4
				NNTM536G2RF3
				NNTM536G2R9W
				NNTM536G2R2N
				NNTM536G2RC0
				NNTM536G2RD1
Classification	Floor Standing (Module configured as part of a system in a Nortel Networks Metrocell Radio Rack)			
Size (m)	NA			
Weight	NA			
Power	-48 VDC			
Functional Description	The MFRM2 CR is a 1 sector, 3 carrier product similar to the MFRM1 except that the MPAM and MTRM that existed in the MFRM1 are integrated into a single module for MFRM2.			

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Physical
Description

The cost-reduced 800MHz MFRM-2 is a 1-sector, 3 carrier CDMA product. The resulting new module, with the same name 800MHz MFRM-2 Radio Module, consists of the following: a new wide voltage range Multi-carrier Power Supply Assembly (MPSA) that replaces the WR HPCA and includes the wide range protector entry module (WR MPEM) and the 5V analog Radio Power Supply Unit (PSU) (that were supplied with previous product); a new artwork for the radio board; a new power amplifier (PA); a new MAC card; interface cables; and mechanical assemblies. The radio board is AW01 (from AW06). The PA board is NTGY33EB AW01. The MAC board is NTGY35AB AW02. The MPSA is from AcBel. A picture of the MFRM2 CR is shown in Figure 1 below.



Figure 1 MFRM2 CR Radio Module

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2.1.1 SET UP CONFIGURATION

Description	P/N	RLS	Serial Number
Radio Rack	NTGS65AA	09	NNTM786016N9
MFRM2 Position 1	NRGY30AA	P5	NNTM536G2RE2
MFRM2 Position 2	NRGY30AA	P5	NNTM536G2R3P
MFRM2 Position 3	NRGY30AA	P5	NNTM536G2RG4
MFRM2 Position 4	NRGY30AA	P5	NNTM536G2RF3
MFRM2 Position 5	NRGY30AA	P5	NNTM536G2R9W
MFRM2 Position 6	NRGY30AA	P5	NNTM536G2R2N
MFRM2 Position 7	NRGY30AA	P5	NNTM536G2RC0
MFRM2 Position 8	NRGY30AA	P5	NNTM536G2RD1
MFRM2 Position 9	not populated		
DPM 1	NTGS89DB	12	CLWVPP2059HB
DPM 2	NTGS89DB	06	CLWVMM1009AF
DPM 3	NTGS89DB	12	CLWVPP2059G9
DPM 4	NTGS89DB	06	CLWVPP2023WP
DPM 5	NTGS89DB	06	CLWVMM1009AN
DPM 6	NTGS89DC	06	CLWVCC100LCQ
DPM 7	NTGS89DB	06	CLWVPP201TKF
DPM 8	NTGS89DC	10	CLWVPP202T8U
DPM 9	NTGS89DB	06	CLWVMM1009BD
Fan Tray 1	NTGS5652	01	NNTM533UCW5F
Fan Tray 2	NTGY60AD	01	NNTM532XLH9H
Fan Tray 3	NTGY60AE	01	NNTM532VW84A
Fan Tray 4	NTGY60AD	01	NNTM538G2RLA
Fan Tray 5	NTGY60AE	01	NNTM538G2N6R
Fan Tray 6	NTGY60AD	01	NNTM538G2W71
Fan Tray 7	NTGS5652	01	NNTM533UC6N9
Fan Tray 8	NTGS5651	01	NNTM535VWG6P
Fan Tray 9	NTGS5651	01	NNTM53586PR6

The setup of the EUT on the turn table is shown in Figure 2 and Figure 3. Setup of the EUT was conducted by the customer.

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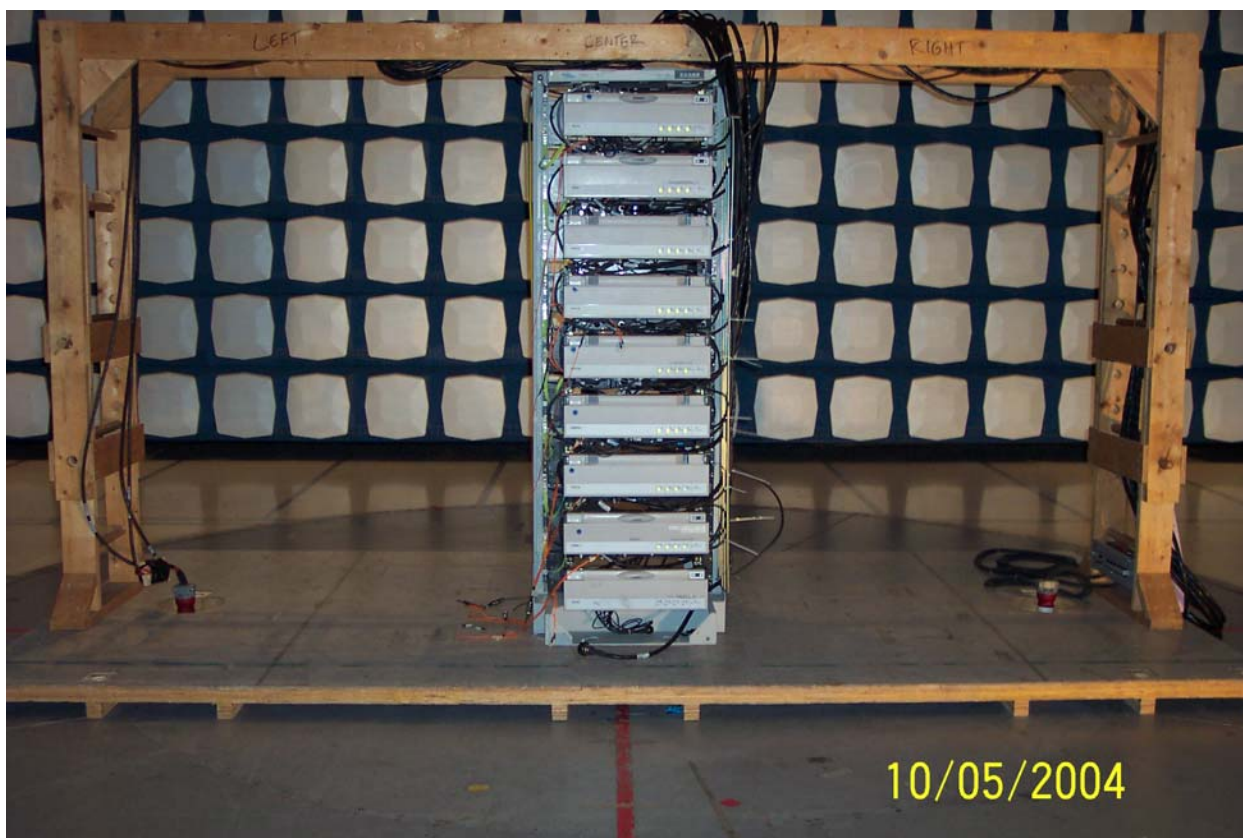


Figure 2 EUT Setup – Front View

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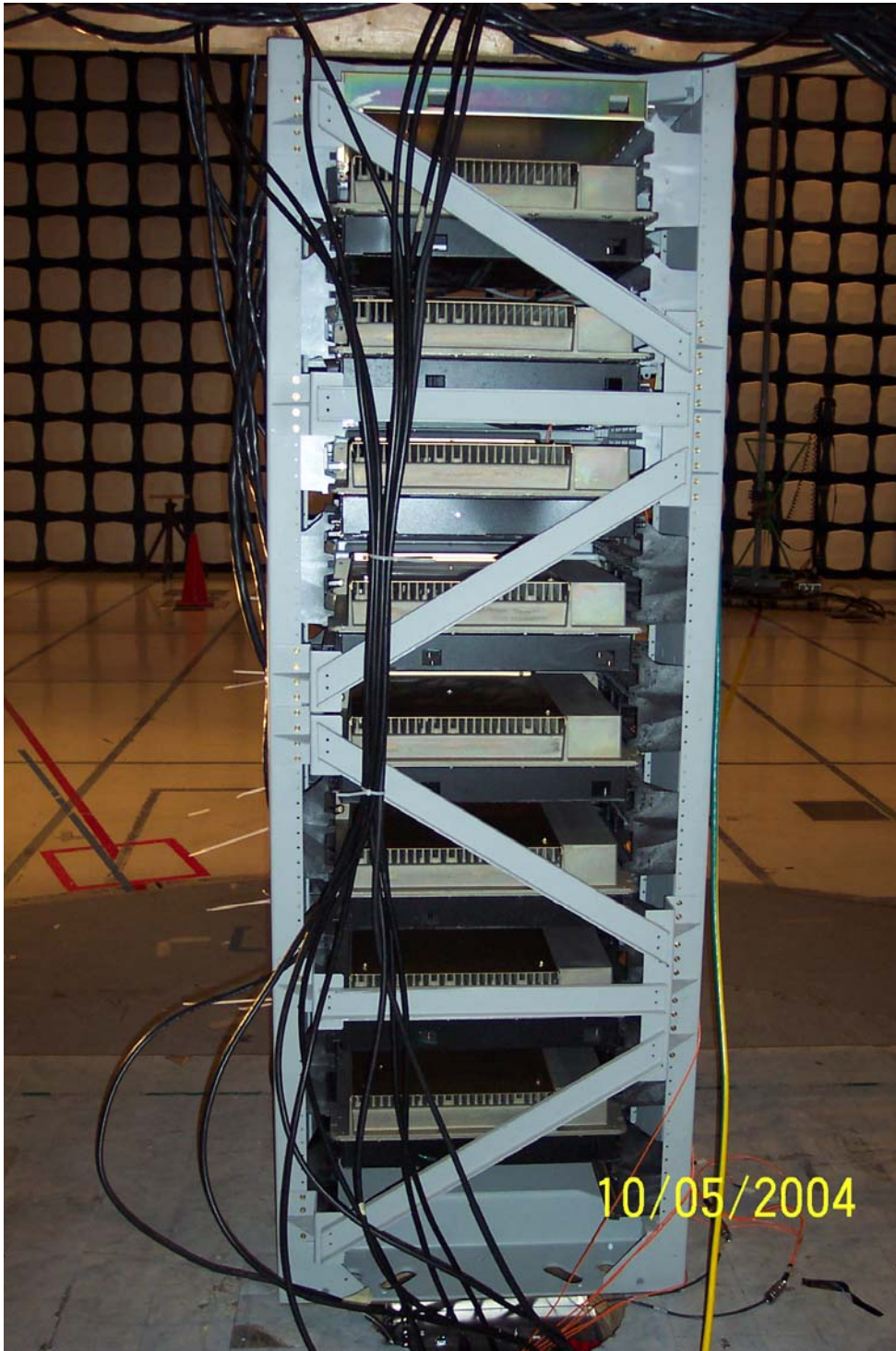


Figure 3 EUT Setup – Rear View

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CG-040023
Report

Emissions Test Report Nortel MFRM2 800MHz CR - FCC Part 22

2.1.2 TEST PLAN CONFIGURATION DEVIATIONS

8 MFRM2 CR were used in the setup instead of the planned 9.

2.1.3 EUT POWER

Voltage	-48 VDC
Number of Feeds	2
Gauge of cable	1/0 AWG
Current Draw	110 AMPS (total combined current – both hubbles)
Special Requirements	The power (1 hot and 1 return per feed) was supplied through a two wire power cord into the EUT.

2.1.4 TEST PLAN POWER DEVIATIONS

None

2.2 CABLES

EUT Cable List

Quantity	Model	Routing		Description	Cable Length (m)
		From	To		
6	NTGS8082	Hubble A	Radios	Radio Power Cable	11
3	NTGS8030	Hubble B	Radios	Radio Power Cable	6
9	LMR400	DPM	Chamber Bulkhead	N Male – N Male Cable	9.2
9	NTGS3525	MFRM2	CORE in digital rack in support room	Fiber	11
1	NA	Hubble A	Radio Break Panel (Powering 6 radios)	1/0 AWG DC Power Cable	5.8
1	NA	Hubble B	Radio Power Cables (Powering 3 radios)	1/0 AWG DC Power Cable	0.3

2.2.1 TEST PLAN CABLE LIST DEVIATIONS

None

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2.3 FREQUENCIES

EUT Frequency List

Module	Frequency(MHz)
MFRM 2 800 MHz CR	39.326
MFRM 2 800 MHz CR	63.6976
MFRM 2 800 MHz CR	78.6432
MFRM 2 800 MHz CR X	638.976

2.3.1 TEST PLAN FREQUENCY LIST DEVIATIONS

None.

2.4 EUT SOFTWARE

Software Name	Software Release Number	Software Description
Not provided by customer		

2.5 MODE OF OPERATION

As defined by Nortel Networks, the EUT was operated in a typical manner. During testing, the customer monitored the system operation. See Section 2.4 for software mode of operation information.

2.5.1 TEST PLAN MODE OF OPERATION DEVIATION

None indicated by customer.

2.6 PASS / FAIL CRITERIA

The pass/fail criteria are defined by the emission limits outlined in each reference base standard. The specific limits are described in each test appendices of this report.

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3.0 SUPPORT EQUIPMENT

3.1 CONFIGURATION

All support equipment information was supplied by the client and was not verified by NTS.

Co-Located Support Equipment/Assemblies

Position	QTY	Description	P/N	Serial Number	Revision Number
No co-located support equipment					

Offsite Support Equipment/Assemblies

Position	QTY	Description	P/N	Serial Number
10m Support Room	1	Digital Rack	NTGS35AB 03	NNTM538NFHNP
10m Support Room	1	BIP	NTBW47BA 01	NNTM74XL0YLN
10m Support Room	1	XCEM1	NTBW70BA 14	NNTM538D9YGG
10m Support Room	1	XCEM2	NTBW70BA 15	NNTM538HGNCE
10m Support Room	1	XCEM3	NTBW70BA 19	NNTM538HKWW9
10m Support Room	1	XCEM4	NTBW70BA 51	NNTM538L8P53
10m Support Room	1	XCEM5	NTBW70BA 51	NNTM538L8P97
10m Support Room	1	XCEM6	NTBW70BA 51	NNTM538L8DPB
10m Support Room	1	XCEM7	NTBW70BA 14	NNTM538D9TNH
10m Support Room	1	XCEM8	NTBW70BA 15	NNTM538HGTT0
10m Support Room	1	XCEM9	NTBW70BA 14	NNTM538D9TWQ
10m Support Room	1	XCEM10	NTBW70BA 11	NNTM53821MJM
10m Support Room	1	XCEM11	NTBW70BA 51	NNTM538L67XA
10m Support Room	1	XCEM12	NTBW70BA 51	NNTM538L8L4Y
10m Support Room	1	TIIM	NTGS3188 04	NNTM74XL1PJ3
10m Support Room	1	GPSTM1	NTBW50AA 07	NNTM74TC0C2F
10m Support Room	1	GPSTM2	NTBW50AA 09	NNTM74TC11O7
10m Support Room	1	CM1	NTBW40BA T4P04	NNTM84C01MDL
10m Support Room	1	CM2	NTBW40AA 23	NNTM538L8RTT
10m Support Room	1	CORE1	NTBW30BA S4	NNTM533GRGJH
10m Support Room	1	CORE2	NTBW30AA 23	NNTM538L8K0T
10m Support Room	1	Digital Shelf	NTBW20BA 04	SNMN5300UC1F
10m Support Room	1	Fan Tray	NTBW18AA 02	NNTM74XA0EX2

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3.2 CABLES

Support Cable List

Quantity	Model	Routing		Description	Cable Length (m)
		From	To		
9	NA	Chamber Bulkhead	Support Room Bulkhead	N Male – N Male Cable	2.14
9	NTMY00CL-SF	Support Room Bulkhead	RF Loads	N Male – N Male Cable	See cable spec

3.3 FREQUENCIES

Support Frequency List

Assembly	Signal	Frequency (MHz)
Not provided by customer.		

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APPENDICES

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APPENDIX A: RADIATED E-FIELD EMISSIONS 30 GHZ – 10 GHZ (ERP MEASUREMENT)

A.1. Base Standard & Test Basis

Base Standard	<input checked="" type="checkbox"/>	CFR Title 47 – Telecommunications, Chapter I - FCC Part 22 – Public Mobile Services – Subpart H – Cellular Radiotelephone Service
	<input type="checkbox"/>	CFR Title 47 – Telecommunications, Chapter I - FCC Part 24 – Personal Communication Services – Subpart E – Broadband PCS
Test Basis		ANSI C63.4-2001 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Test Method		NTS Radiated Emissions Test Method E006R4 NTS Radiated Emissions Signal Substitution Method 30MHz - 20GHz. EMC Test Method 11.0, Revision 01

A.2. Specifications

Frequency	<input checked="" type="checkbox"/>	47 CFR FCC Part 22
	<input type="checkbox"/>	47 CFR FCC Part 24
		Theoretical Peak @ 3m ¹
		ERP ²
MHz		dBμV/m
1000 - 18000		84.3
		-13

Note 1: Calculated using: $P_d - (43 + 10 \log(P_w))$

where P_d is the EUT power in dBm and P_w is the EUT power in watts

Note 2: Calculated using: $120 + 20 \log(\text{SQRT}(49.2 * P_w) / 3)$

where P_w is the EUT power in watts

A.3. Measurement Uncertainty

Frequency Range	Measurement Uncertainty (dB)	Expanded Uncertainty (K=2) (dB)
30 MHz – 1 GHz	+2.32/-2.36	+4.65/-4.72
1 GHz – 10 GHz	+3.48/-3.51	+6.96/-7.02

A.4. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
None						

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A.5. Radiated Emissions Measurement Equipment

Radiated Emissions 30 MHz – 1 GHz Measurement Equipment

Description	Manufacturer	Type/Model	Asset #	Cal Due	Cal Date
10m ANECHOIC CHAMBER					
Bilog Antenna	<input type="checkbox"/> Chase	CBL 6111B	260301	09JULY05	09JULY04
	<input checked="" type="checkbox"/> Chase	CBL6112B	260398		
RF Cable	Suhner Succoflex	Ferrite bead loaded cable	260388	07JAN06	07JAN04
CONTROL ROOM					
Test Receiver	<input type="checkbox"/> Rohde & Schwarz	ESMI	260424 / 260423	27MAR05	27MAR04
	<input checked="" type="checkbox"/> Rohde & Schwarz	ESMI	260424 / 260423		
Mast Controller	EMCO	2090	260166	N/A	N/A
Multi Device Controller TT1 (Turntable)	EMCO	2090	260165	N/A	N/A
RF 10m East site Link				07JAN06	07JAN04
- Cable 1	Suhner Succoflex	NA	263191		
- Cable 2	Suhner Succoflex	NA	263135		
- Cable 3	Suhner Succoflex	NA	263161		
- Cable 4	Suhner Succoflex	NA	263162		
- Switch Matrix Controller	TDL	SMC-002	260162		
- Amplifier	Hewlett Packard	8447F	260164		

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Radiated Emissions 1 GHz – 10 GHz Measurement Equipment

Description	Manufacturer	Type/Model	Asset #	Cal Due	Cal Date
10m ANECHOIC CHAMBER					
Horn Antenna (Rx) 1 G – 18 G	<input checked="" type="checkbox"/> EMCO	3115	260092	16JUN05	16JUN04
Standard Gain Horn (Rx) 5.95 G – 8.2G	<input type="checkbox"/> EMCO	3160-06	260090	27NOV04	27NOV01
Standard Gain Horn (Rx) 8.2G – 12.5 G	<input type="checkbox"/> EMCO	3160-07	260089	27NOV04	27NOV01
Standard Gain Horn (Rx) 12.5G – 18 G	<input type="checkbox"/> EMCO	3160-08	260074	27NOV04	27NOV01
High pass filter	K&L	11SH10-3860	263124	08JAN06	08JAN04
High frequency Link				07JAN06	07JAN04
Step Attenuator/Switch (0dB & 10 dB)	HP	11713A	260048 260097		
LNA	Miteq	JSD000121	260477		
Cable from LNA to SA	Succoflex	101PEA	263187		
Spectrum Analyzer 9k-40GHz	Rohde & Schwarz	FSEK	260104	27MAR05	27MAR04
LNA DC Power Supply	Xantrex	LXO 30-2	260483	NA	NA
HPIB Extender	HP	37204	260096	N/A	N/A
10dB Attenuator	Wiltron	41KC-10	260449	05APR05	05APR04
CONTROL ROOM					
PC with FSEK Manual ctrl S/W	N/A	N/A	N/A	N/A	N/A
HPIB Extender	HP	37204	260168	N/A	N/A
Mast Controller	EMCO	2090	260166	N/A	N/A
Multi Device Controller TT1	EMCO	2090	260165	N/A	N/A
VERIFICATION EQUIPMENT					
Horn Antenna (Tx)	<input checked="" type="checkbox"/> EMCO	3115	260088	N/A	N/A
Signal Generator	<input checked="" type="checkbox"/> Rohde & Schwarz	SMP-04	260425	N/A	N/A
	<input type="checkbox"/> Rohde & Schwarz	SMIQ		N/A	N/A
Cable RX antenna to 3M center bulk head	Succoflex	104	263136	N/A	N/A
Cable 3M center bulk head to Control room	Succoflex	104	263188	N/A	N/A
Cable Control room bulk head to Signal Generator	Succoflex	104	263134	N/A	N/A

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A.6. Special Considerations

None.

A.7. Test Results

Compliance Scan Summary

 Product Integrity Laboratory V2.5			Project Name: CG-040023 Model: MFRM2 CR Comments: -48VDC, 8MFRM2_800MHzCR					Tester: Eric Warkentin Test ID: RE03c-10m-2004-CG-040023										
Standard			FCC 22		3 meters													
	Rx Antenna	Tx Antenna	Frequency	E-Field Peak Emission Level	Substituted Measured Rx Level	Rx AF	Rx Link	Rx FL	Total Rx CF	Det	Substituted Rx E-Field Emission	Signal Generator	Tx Num Gain	Tx Cable	Total Tx CF	Effective Radiated Power (E.R.P.)	ERP Limit	ERP Margin
			MHz	dBuV/m	dBuV	dB/m	dB	dB	dB		dBuV/m	dBm	dB	dB	dB	dBm	dBm	dB
Hpol	260092	260091	1754.51	68.83	71.69	26.42	-29.20	0.00	-2.78	PK	68.91	-34.80	7.23	6.71	0.52	-34.28	-13.00	21.28
Vpol	260092	260091	1759.80	68.29	71.12	26.39	-29.19	0.00	-2.80	PK	68.32	-34.90	7.18	6.77	0.41	-34.49	-13.00	21.49

AF: Antenna Factors Link: Link Loss FL: Filter Loss CF: Correction Factor Det: Detector Type Rx: Receive Tx: Transmit
Link = Attenuator Loss+Cable Loss + Amplifier Loss Rx E-Field Emission = Measured Rx Level + AF + Link + FL E.R.P. = Signal Generator + Tx Num Gain - Tx Cable

E-Field Peak Emissions Level: Corrected level measured from the system
Substituted Measured Rx Level: Uncorrected level measured from substitution transmit antenna
Substituted Rx E-Field Emission: Corrected level measured from the substitution transmit antenna

The EUT is in compliance with the limits as specified above.

Notes:

- No radio emissions seen below 1.7 GHz or above 4.5 GHz
- Frequencies chosen from compliance are radio harmonics, all other emissions are digital harmonics and fall under Part 15 tests.

A.8. Observations

None

A.9. Deviations from Normal Operating Mode During Test

None

A.10. Sample Calculation

3m Limit = 10m Limit – 20 * log (3/10)

Emission Level = Measured Level + Correction Factors

Margin = Limit – Emission Level

ERP Limit (dBm) = Pd-(43 + 10 log(Pw))

where Pd is the EUT power in dBm and Pw is the EUT power in watts

Theoretical ERP Limit (dBuV/m) $120+20\log(\text{SQRT}(49.2*Pw)/3)$

where Pw is the EUT power in watts

A.11. Test Data & Photographs

The test data and photographs collected during this test appear following this page.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.



A.12. Tested By

This testing was conducted in accordance with the ISO 17025:1999 scope of accreditation, table 1; Quality Manual.

Name: Eric Warkentin
Function: EMC Specialist

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Figure 4 RE 30 MHz - 1 GHz EUT Configuration

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Figure 5 RE 1 GHz – 18 GHz EUT Configuration

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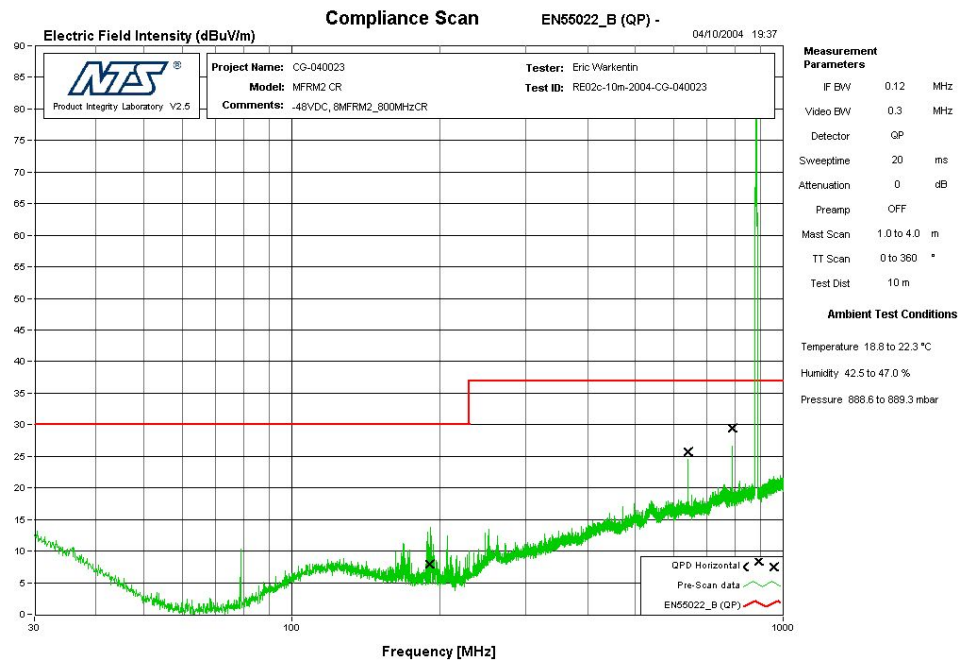


Figure 6 RE - Horizontal – 30 MHz – 1 GHz Pre-scan
Note: Limit line shown is for EN 55022 Class B, not FCC Part 22

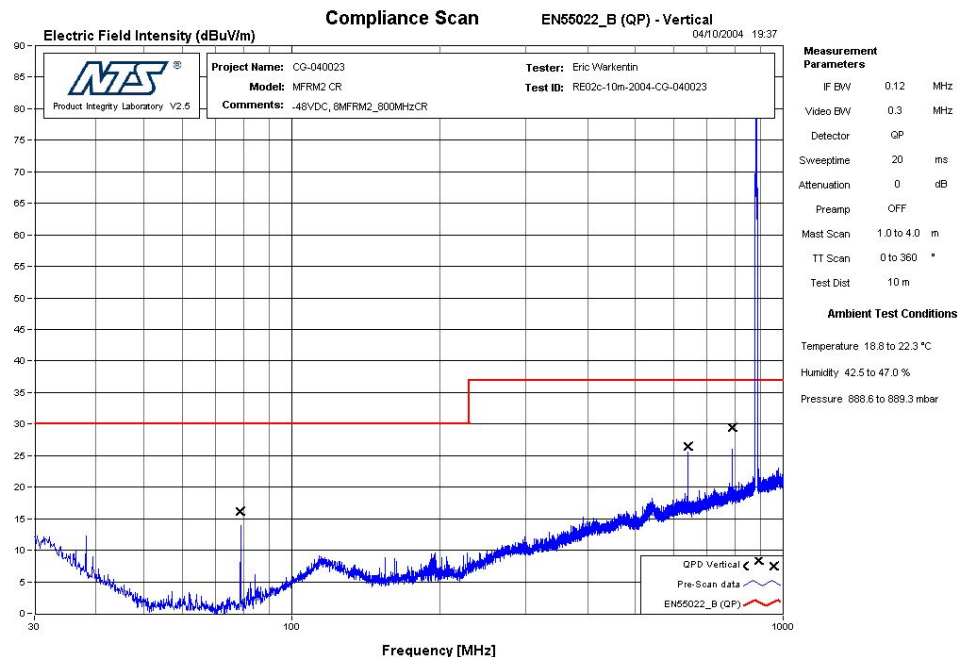


Figure 7 RE - Vertical – 30 MHz – 1 GHz Pre-Scan
Note: Limit line shown is for EN 55022 Class B, not FCC Part 22

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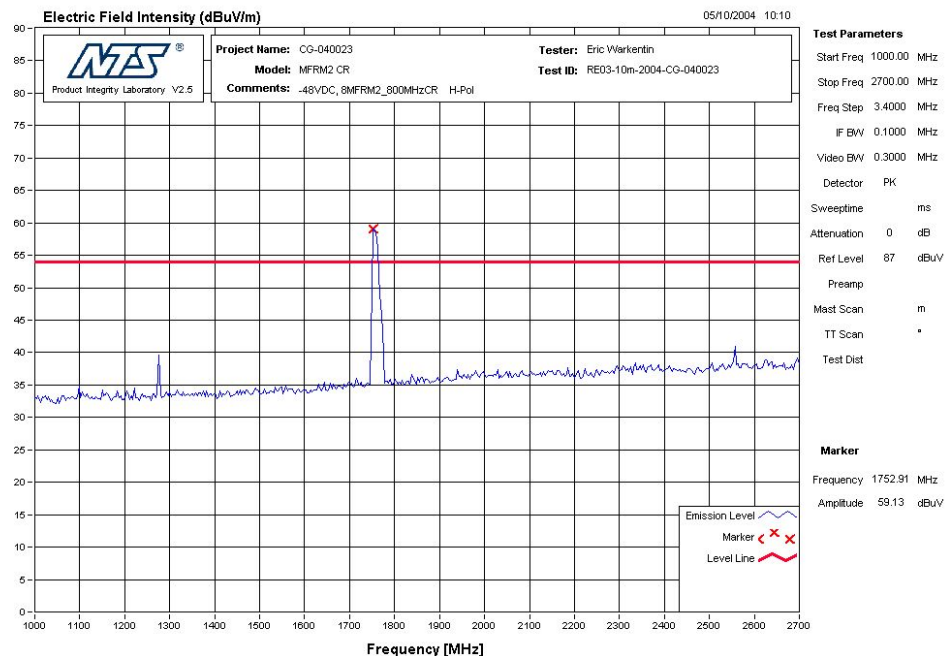


Figure 8 RE - Horizontal – 1 GHz – 2.7 GHz Pre-scan
Note: Limit line shown is for Part 15 Class B, not Part 22

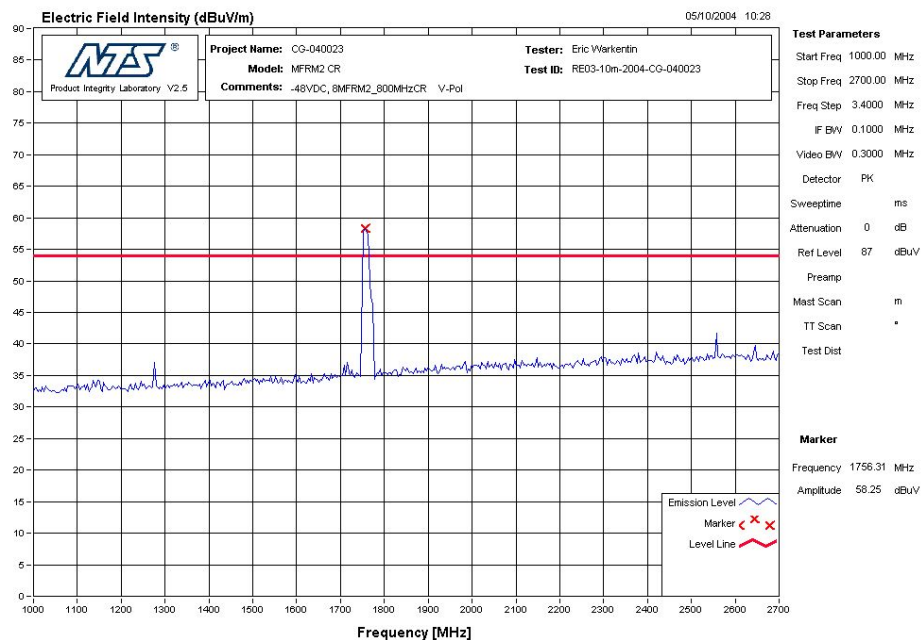


Figure 9 RE - Vertical – 1 GHz – 2.7 GHz Pre-Scan
Note: Limit line shown is for Part 15 Class B, not Part 22

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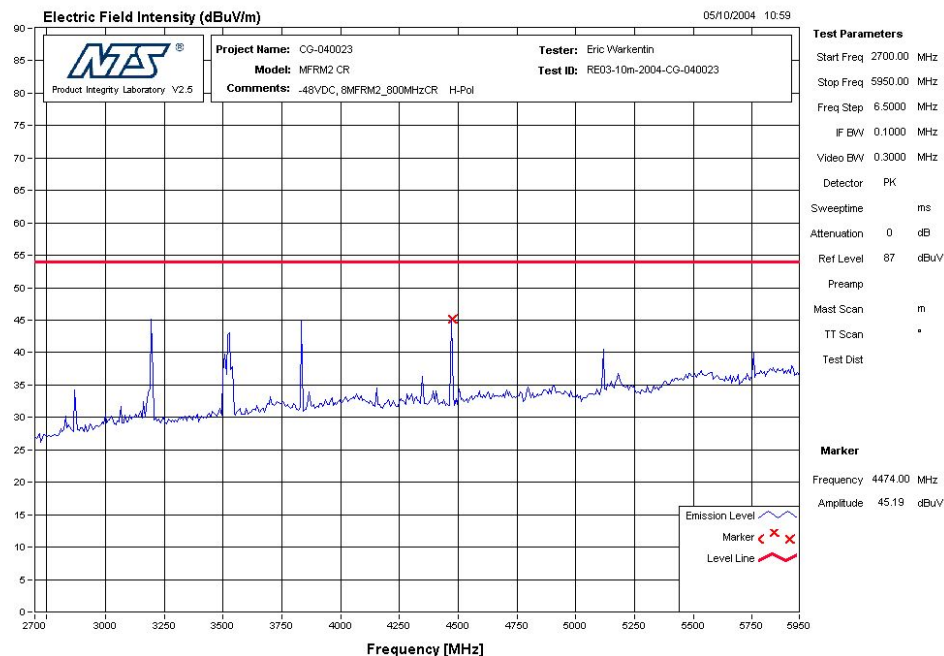


Figure 10 RE - Horizontal - 2.7 GHz - 5.95 GHz Pre-scan
Note: Limit line shown is for Part 15 Class B, not Part 22

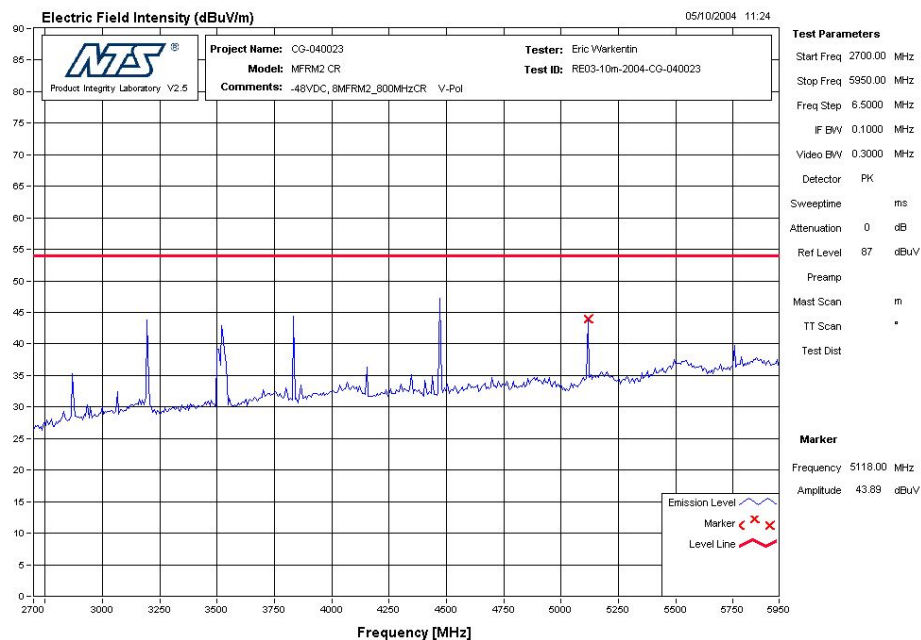


Figure 11 RE - Vertical - 2.7 GHz - 5.95 GHz Pre-Scan
Note: Limit line shown is for Part 15 Class B, not Part 22

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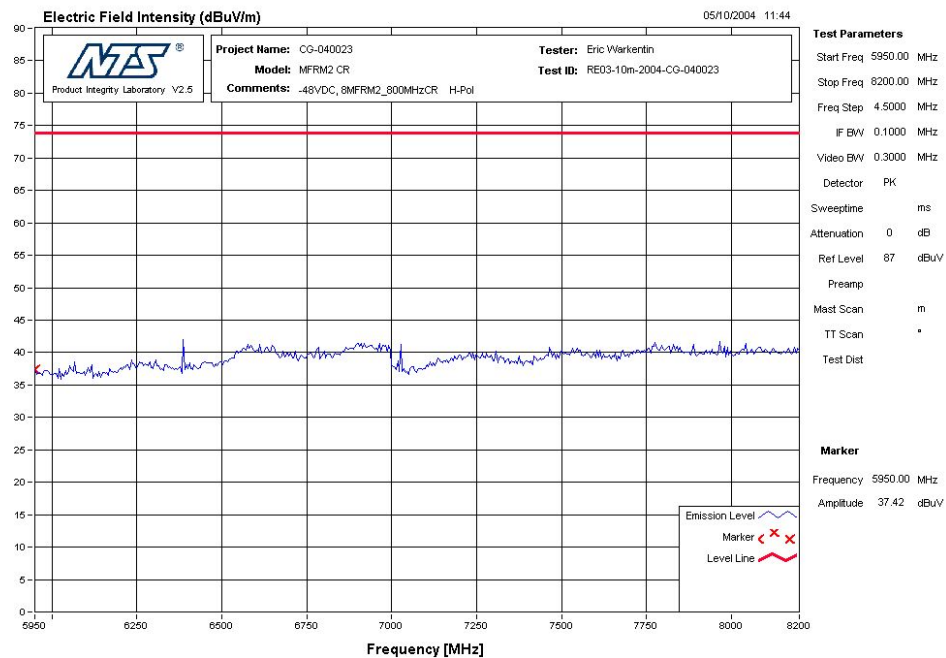


Figure 12 RE - Horizontal – 5.95 GHz – 8.2 GHz Pre-scan

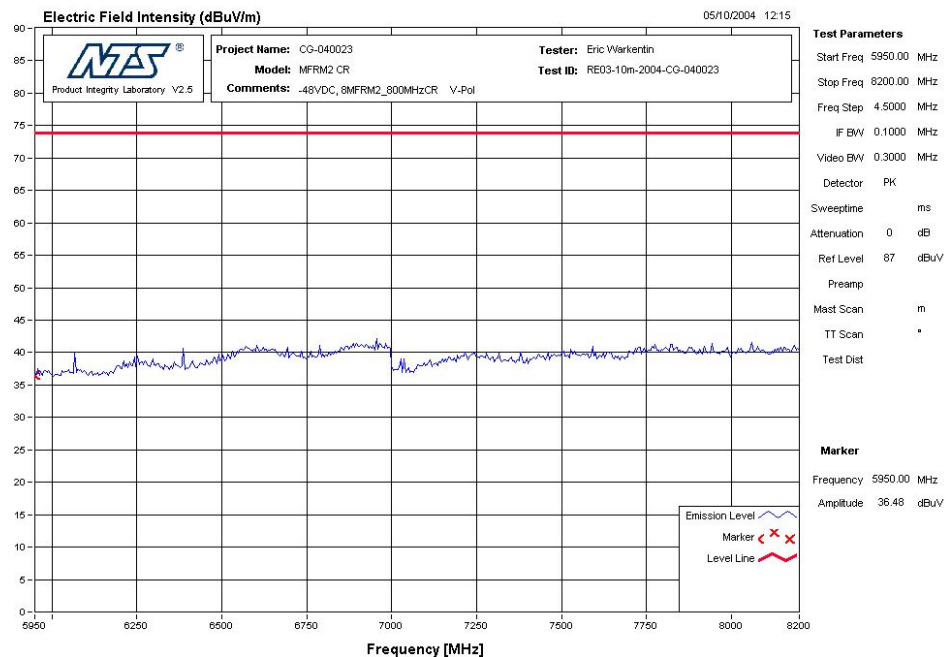


Figure 13 RE - Vertical – 5.95 GHz – 8.2 GHz Pre-Scan

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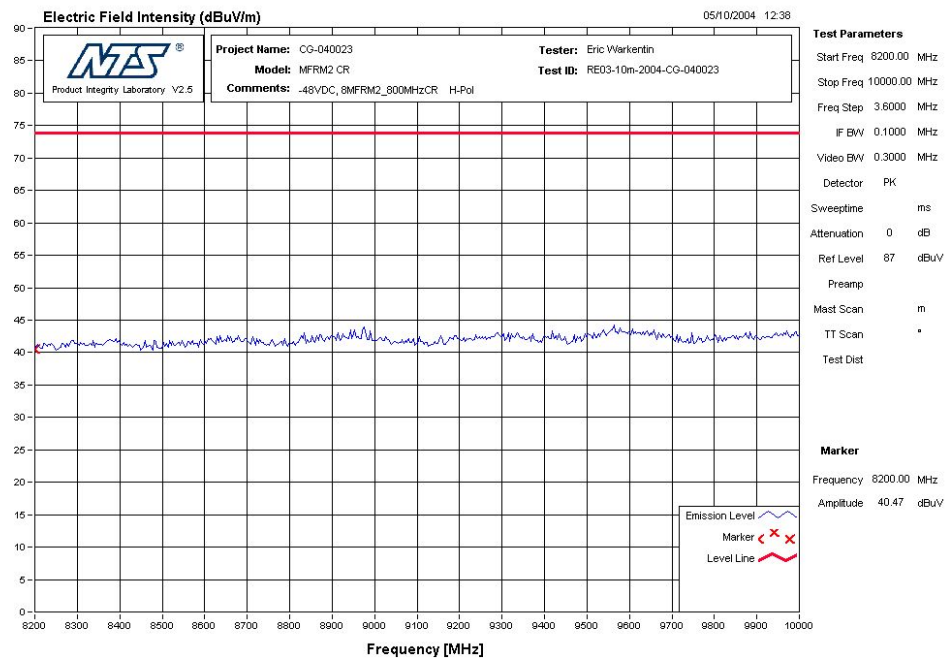


Figure 14 RE - Horizontal – 8.2 GHz – 10 GHz Pre-scan

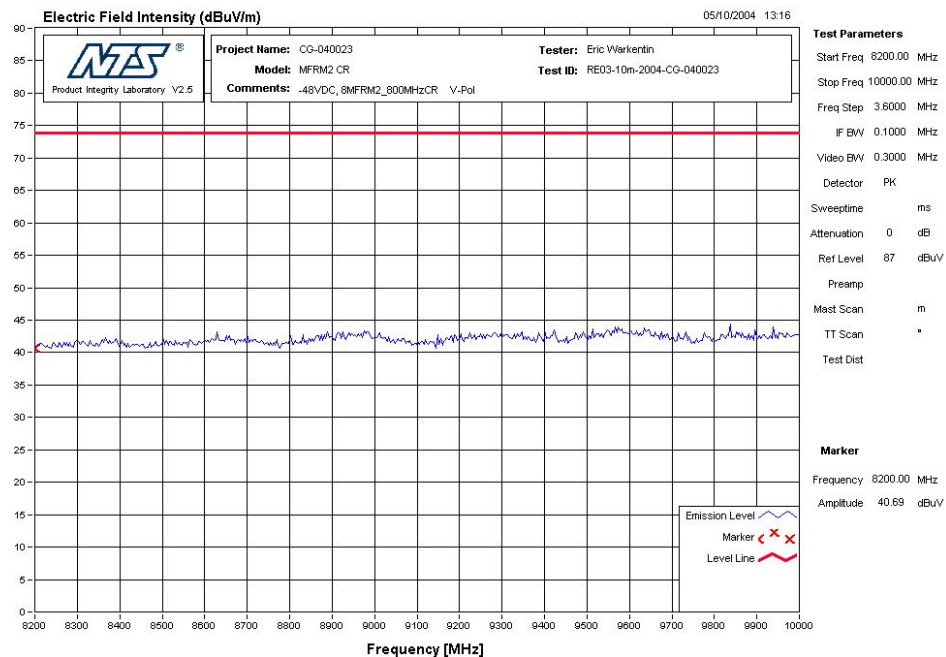


Figure 15 RE - Vertical – 8.2 GHz – 10 GHz Pre-Scan

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Figure 16 RE 1 GHz – 10 GHz EUT Configuration

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APPENDIX B: TEST PLAN

Not Attached

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APPENDIX C: SUPPLEMENTARY INFORMATION

None attached

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END OF DOCUMENT

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